TRANSLATOR'S STATEMENT

I, Yuki Nakamura, hereby state that I am knowledgeable in the Japanese and English languages, and that the attached document is, to the best of my knowledge and belief, a true and accurate English language translation of Japanese Application No. 2002-208595 filed on July 17, 2002.

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[Document] Specification

[Title of the invention] Occupant determining device

[Scope of claims]

[Claim1]

An occupant determining device, comprising:

a load sensor arranged at a seat body; and

a controller calculating a detected load value based on an output load value of the load sensor and performing an occupant determination based on the detected load value, wherein the occupant determination state is switched to an adult occupant determination by setting a delay time when the detected load value exceeds a determination threshold and a greater or less relation between the detected load and the determination threshold is inversed, wherein the controller includes a plurality of the determination thresholds, and the larger each determination threshold exceeded by the detected load value is, the shorter the delay time is set by the controller.

[Claim2]

An occupant determining device according to Claim 1, wherein the controller includes a first determination threshold and a second determination threshold that is larger than the first determination threshold, the controller sets a first delay time corresponding to the first determination threshold and a second delay time corresponding to the second determination threshold, and the second delay time is shorter than the first delay time.

[Detailed explanation of the invention]

[001]

[Field of the invention]

This invention relates to an occupant determining device, which performs an occupant determination based on an output load value of a load sensor arranged at a seat body.

[0002]

[Prior art]

Conventionally, for example, when an air bag device is included in a vehicle in order to protect a person (occupant) seated on a seat of the vehicle, an occupant determining device is provided to the seat of the vehicle in order to determine whether or not the seated occupant exists on the objective seat or whether the seated occupant is, for example, an adult or a child. As such occupant determining device, for example, an occupant determining device disclosed in a Japanese Patent Laid-open Publication 1997207638A is known. This occupant determining device includes a plurality of load sensors and a controller. The load sensors are respectively provided on a plurality of mounting positions of a seat body relative to a vehicle floor. The controller calculates

a detected load value based on output load values of the load sensors and determines whether or not a seated occupant exists on the vehicle seat in accordance with the detected load value calculated by the controller. In particular, the controller calculates a detected load value by adding output detected load values of each load sensor into an adder, compares this detected load value to a predetermined load value (determination threshold) in a determination processing circuit, and determines whether or not the seated occupant exists in the vehicle according to a greater or less relation between the detected load value and the determination threshold.

[0003]

Meanwhile, in such occupant determining device, a load being applied to the load sensor varies due to a swinging movement or posture variations of a seated occupant while the vehicle is driven. Thus, a low-pass filter is applied to each sensor signal or delay processing is conducted when the occupant determination state is switched due to the inverse of the greater or less relation between the detected load value and the determination threshold in order to prevent frequent switching in the occupant determination state due to temporal load variations. Accordingly, temporal switching of the occupant determination state (for example, from an adult occupant determination to a child occupant determination) due to the swinging movement or posture variations of the seated occupant is prevented.

[0004]

[Objects to be solved by the invention]

Meanwhile, in the case where the delaying processing is conducted in such occupant determining device for switching the occupant determination state, for example, when the occupant determination state is switched to a different determination from the actual condition due to a change of the posture of the seated occupant, the different occupant determination continues due to the above delaying processing even if the posture of the occupant is normalized. Accordingly, a delay in returning to the actual occupant determination may occur. More specifically, when a child occupant is replaced with an adult occupant, a delay in the occupant determination may similarly occur.

[0005]

The object of the present invention is to provide an occupant determining device, which can appropriately conduct an adult occupant determination based on the weight of an occupant.

[0006]

[Means to solve an object]

In order to solve the above-mentioned problems, as a summary of the invention

described in Claim 1, an occupant determining device includes a load sensor arranged at a seat body and a controller calculating a detected load value based on an output load value of the load sensor and performing an occupant determination based on the detected load value, wherein the occupant determination state is switched to an adult occupant determination by setting a delay time when the detected load value exceeds a determination threshold and a greater or less relation between the detected load value and the determination threshold is inversed, wherein the controller includes a plurality of the determination thresholds, and the larger each determination threshold exceeded by the detected load value is, the shorter the delay time is set by the controller.

[0007]

In the occupant detecting device according to Claim 1, as a summary of the invention described in Claim 2, the controller includes a first determination threshold and a second determination threshold that is larger than the first determination threshold, the controller sets a first delay time corresponding to the first determination threshold and a second delay time corresponding to the second determination threshold, and the second delay time is shorter than the first delay time.

[0008]

[Effect]

According to the invention described in Claim 1, the larger the determination threshold exceeded by the detected load value is, the shorter the delay time is set. Thus, in regard to an occupant who is most likely to be an adult occupant such as a heavy occupant, the larger the determination threshold exceeded by the detected load value Ws is, the shorter the delay time is set. Accordingly, the adult occupant determination is immediately made.

[0009]

According to the invention described in Claim 2, the controller includes two determination thresholds and sets two types of the delay time corresponding to each determination threshold. Accordingly, a calculation load for the adult occupant determination based on the weight of an occupant is reduced.

[0010]

[Embodiment of the invention]

Hereinafter, a vehicle seat to which an embodiment of the present invention is applied will be described with reference to Figs. 1 to 6.

[0011]

Fig. 1 illustrates a perspective view of a seat body 1 arranged at the vehicle seat. This seat body 1 is arranged at a passenger seat for a vehicle. In Fig. 1, a bilateral pair of

supporting frames 2 is arranged in a longitudinal direction of the vehicle (a direction shown by an X arrow in Fig. 1) so as to be fixed to a vehicle floor that is not shown.

[0012]

A pair of brackets 3 located in the longitudinal direction of the vehicle is fixed to an upper surface of each of the supporting frames 2. A lower rail 4 is supported by and fixed to the brackets 3 along the supporting frame 2 in the longitudinal direction of the vehicle. A bilateral pair of the lower rails 4 is formed to be an approximately U-shaped cross section with an upward opening. The opening of each of the lower rails 4 forms a slide groove 5 extending in the longitudinal direction of the vehicle.

[0013]

A bilateral pair of upper rails 6 is arranged in the slide grooves 5 formed at the respective lower rails 4 so as to be slidably movable in the longitudinal direction of the vehicle along the slide grooves 5. As shown in Fig. 2, lower arms 16, which supports a seat cushion 9 and a seat back 10 of the seat body 1 via a bilateral pair of front sensor brackets 7 and a bilateral pair of rear sensor brackets 8, are connected to the respective upper rails 6 while having predetermined spaces relative to the upper rails 6.

[0014]

As shown in Fig. 3(a), each of the front sensor brackets 7 is provided with an upper fastening portion 7a and a lower fastening portion 7b at the upper and lower ends. The front sensor bracket 7 is provided with a flexible portion 7c, which is formed by curving a portion located between the upper fastening portion 7a and the lower fastening portion 7b. The front sensor bracket 7 is connected to a front side of the lower arm 16 and a front side of the upper rail 6, respectively at the upper fastening portion 7a and the lower fastening portion 7b. In addition, a right-side front load sensor 21 and a left-side front load sensor 22, each configuring a front load sensor, are attached to the flexible portions 7a of the respective right-side and left-side sensor brackets 7. These right-side and left-side front load sensors 21 and 22 include detecting elements, for example, each serving as a strain gauge. The front load sensors 21 and 22 are configured to electrically detect a flexible amount of the flexible portions 7c in response to a load applied to the seat cushion 9.

[0015]

As shown in Fig. 3 (b), each of the rear sensor brackets 8 is provided with an upper fastening portion 8a and a lower fastening portion 8b. The rear sensor bracket 8 is provided with a flexible portion 8c, which is formed by curving a portion located between the upper fastening portion 8a and the lower fastening portion 8b. The rear sensor bracket 8 is connected at the upper fastening portion 8a and the lower fastening

portion 8b to a rear side of the lower arm 16 and a rear side of the upper rail 6, respectively. In addition, right-side and left-side rear load sensors 23 and 24 each configuring a rear load sensor are attached to the flexible portions 8c of the respective rear sensor brackets 8. These right-side and left-side rear load sensors 23 and 24 include detecting elements, for example, each serving as a strain gage in the same way as the above-mentioned right-side and left-side front load sensors 21 and 22. The rear load sensors 23 and 24 are configured to electrically detect a flexible amount of the flexible portions 8c in response to a load applied to the seat cushion 9.

[0016]

Fig. 4 is a block diagram showing an electric structure of an occupant determining device 20 provided at the vehicle seat. This occupant determining device 20 includes the above-mentioned load sensors 21 to 24 and a controller 25.

[0017]

The controller 25 includes a central processing unit 26 (hereinafter referred to as "CPU"), a sensor signal input circuit 27, and an output circuit 28. The sensor signal input circuit 27 has active filters 27a, 27b, 27c, and 27d respectively provided to so as to correspond to the right-side front load sensor 21, the left-side front load sensor 22, the right-side rear load sensor 22, and the left-side rear load sensor 24. Further, load signals from the load sensors 21 to 24 are input to the CPU 26 through the active filters 27a to 27d. In addition, the active filters 27a to 27d are known low-pass filters configured in combination of passive elements including, for example, condensers and resistors, and active elements such as amplifiers. Accordingly, only low frequency signals among the load signals from the load sensors 21 to 24 are passed through the active filters 27a to 27d, and other signals are cut off.

[0018]

Additionally, an output load value FR of the right-side front load sensor 21 and an output load value FL of the left-side front load sensor 22 are respectively calculated in the CPU 26 in accordance with the load signals from the load sensors 21 and 22, which have passed through the active filters 27a and 27b, respectively. Moreover, an output load value RR of the right-side rear load sensor 23 and an output value RL of the left-side rear load sensor 24 are respectively calculated in the CPU 26 in accordance with the load signals from the load sensors 23 and 24, which have passed through the active filters 27c and 27d, respectively. Further, the CPU 26 calculates a detected load value Ws by summing these output load values FR, FL, RR, and RL.

[0019]

The aforementioned CPU 26 performs various calculations in accordance with a control

program and initial data that are stored in the CPU 26 in advance. The CPU 26 outputs a calculation result, that is, an occupant determination result to the output circuit 28. Then, the calculation result is output, for example, to an air bag controller 30 through the output circuit 28, thereby controlling the operation of the air bag device.

[0020]

Next, the processing of occupant determinations in the embodiment will be explained with reference to time charts of Fig. 5 and Fig. 6. In addition, the CPU 26 determines whether an occupant is an "adult", a "child" or "no occupant" is seated in accordance with the detected load value Ws. Furthermore, the CPU 6 measures the time for various types of delaying processing at the timing of determination switching by using the internal timer.

[0021]

In Figs. 5 and 6, a first determination threshold Wth1 and a second determination threshold Wth2 are predetermined thresholds, which are set in order to conduct an adult occupant determination. The second determination threshold Wth2 is set to be larger than the first determination threshold Wth1. The first determination threshold Wth1 is set at a value suitable for appropriately conducting the adult occupant determination by comparison in a greater or less relation of the first determination threshold Wth1 and the detected load value Ws. Meanwhile, the second determination threshold Wth2 is set at a value suitable for further reliably performing the adult occupant determination by comparison in a greater or less relation of the second determination threshold Wth2 and the detected load value Ws. In other words, the second determination threshold Wth2 is set so that the adult occupant determination is performed under a more strict condition (larger threshold), thereby increasing the reliability of the adult occupant determination. In addition, a transition of the occupant determination state under the condition where the detected load value Ws is below the first determination threshold Wth1 and a child occupant determination is made, will be explained here. Such condition occurs when the detected load value Ws decreases, for example, due to posture variations of the occupant and then the child occupant determination is fixed. Obviously, when the detected load value Ws is sufficiently small, no occupant determination is made and fixed similarly to the above-mentioned transition case. Therefore, an explanation of a transition of the occupant determination state under the condition where no occupant determination is made and fixed, is omitted.

[0022]

In Fig. 5, when the detected load value Ws exceeds the first determination threshold Wth1 at time "T1", the CPU 26 starts measuring an elapsed time under the condition

where the detected load value Ws is the first determination threshold or more while not exceeding the second determination threshold Wth2 (Wth1 ≤ Ws < Wth2). Thereafter, when the elapsed time exceeds a first predetermined time A as a first delay time, the CPU 26 switches the occupant determination state from the child occupant determination to the adult occupant determination. The first predetermined time A corresponding to the first determination threshold Wth1 is set as the time for the delay processing. The first predetermined time A is set to be a comparatively long time for preventing temporary switching of the occupant determination (from the child occupant determination to the adult occupant determination) due to the swinging movement or posture variations of the occupant. Thereafter, the adult occupant determination continues after a period of time (T1 + A) elapses.

[0023]

On one hand, in Fig.6, when the detected load value Ws exceeds the second determination threshold Wth2 at time "T2", the CPU 26 starts measuring an elapsed time under the condition where the detected load value Ws is the second determination threshold Wth2 or more (Ws ≥ Wth2). Thereafter, when the elapsed time exceeds a second predetermined time B as a second delay time, the CPU 26 switches the occupant determination from the child occupant determination to the adult occupant determination. The second predetermined time B corresponding to the second determination threshold Wth2 is set as the time for the delay processing. The second predetermined time B is set at a value for preventing the temporary switching of the occupant determination (switching from the child occupant determination to the adult occupant determination) due to the swinging movement or posture variations of the occupant. In this regard, in response to the case where the detected load value Ws exceeds a threshold (second determination threshold Wth2), which is a more strict condition (larger threshold) for the adult occupant determination, the more the reliability of the adult occupant determination increases, the shorter the second predetermined time B is set relative to the first predetermined time A. Accordingly, the adult occupant determination continues after a period of time (T2 + B) elapses.

[0024]

As explained above, according to the embodiment of the present invention, the following mentioned effects will be obtained.

(1) In the embodiment, the larger the determination threshold exceeded by the detected load value Ws is, the shorter the delay time is set. Thus, in regard to an occupant who is most likely to be an adult such as a heavy occupant, the larger the determination threshold exceeded by the detected load value Ws is, the shorter the delay time is set.

Accordingly, the adult occupant determination can be immediately made.

[0025]

Consequently, even when the occupant determination state is switched to a different determination (child occupant determination) from the actual condition due to posture variations of the occupant, the posture of the occupant if heavy is normalized, so that the child occupant determination immediately returns to the actual occupant determination (adult occupant determination).

[0026]

Likewise, even in the case where a child occupant is replaced with an adult occupant, the child occupant determination is immediately switched to the actual occupant determination (adult occupant determination) if the adult occupant is heavy. Alternatively, even in the case where another adult gets into the vehicle, the occupant determination state is immediately switched from a different determination (no occupant determination) to the actual occupant determination (adult occupant determination) if the adult occupant is heavy.

[0027]

(2) Two determination thresholds (first and second determination thresholds Wth1, Wth2) are provided in the embodiment, and two types of the delay time (first predetermined time A and second predetermined times B) corresponding to each determination threshold are provided. Accordingly, a calculation load for the adult occupant determination based on the weight of an occupant can be reduced.

[0028]

(3) In the embodiment, in regard to an occupant who is unlikely to be an adult such as a light occupant, since the above delay time is set to be longer, frequent switching of the occupant determination due to temporary load variations can be prevented.

[0029]

In addition, an embodiment of the present invention is not limited to the above-described embodiment and may be modified as follows.

- According to the above-described embodiment, the occupant determination state is switched to the adult occupant determination in accordance with the elapsed time under the condition where the detected load value Ws is the first determination threshold Wth1 or more while not exceeding the second determination threshold Wth2 ($Wth1 \leq Ws < Wth2$) (see Fig. 5). Correspondingly, without reference to the second determination threshold Wth2, the occupant determination state may be switched to the adult occupant determination in accordance with the elapsed time under the condition where the detected load value Ws is the first determination threshold Wth1 or more

(Wth1 $\leq$ Ws). In this case, when the detected load value Ws exceeds the second determination threshold Wth2, an elapsed time corresponding to the second determination threshold Wth2 is measured in addition to an elapsed time corresponding to the first determination threshold Wth1. When either elapsed time reaches the corresponding delay time, the occupant determination state is switched to the adult occupant determination.

[0030]

- Two determination thresholds each compared with the detected load value Ws in the greater or less relation therebetween and two types of the delay time corresponding to each determination threshold are set in the embodiment. Correspondingly, three determination thresholds and three types of the delay time corresponding to each determination threshold may be set. Basically, the larger the determination threshold exceeded by the detected load value Ws is, the shorter the delay time may be set.

[0031]

- In the embodiment, a bilateral pair of the right-side front load sensor 21 and the left-side front load sensor 22 is provided at front portions of the seat body 1 and a bilateral pair of the right-side rear load sensor 23 and the left-side rear load sensor 24 is provided at rear portions of the seat body 1. Such number of the load sensors (four load sensors) and the arrangement are only examples and different number of load sensors and the arrangement may be applied. That is, a single load sensor is arranged at a predetermined position of the seat body 1 or plural load sensors are arranged at predetermined positions of the seat body 1, so that a seated occupant is determined in accordance with a load value detected by the single load sensor or load values detected by the plural load sensors.

[0032]

- The shapes of the sensor brackets 7 and 8 applied in the above embodiment are only examples and the shapes may be arbitrarily applied as far as flexure occurs depending on to the weight of the seat (load applied to the seat due to a seated occupant).

[0033]

- The mounting positions of the load sensors 21 to 24 (front and rear sensor brackets 7, 8) applied in the above embodiment are only examples. The mounting positions may be arbitrarily applied as far as the weight of the seat (load applied to the seat due to the seated occupant) is detected.

[0034]

- The case where the vehicle seat is the passenger seat is explained in the above embodiment but the vehicle seat may be a driver seat.

- The setting of the delay time when the occupant determination state is switched from the child occupant determination to the adult occupant determination after the detected load value Ws exceeds the determination threshold is explained in the embodiment. However, accordingly, a delay time when the occupant determination state is switched from the adult occupant determination to the child occupant determination may be set. That is, in the case where the greater or less relation between the detected load value Ws and the determination threshold is inversed after the detected load value Ws exceeding the determination threshold decreases below the determination threshold, a plurality of determination thresholds may be set, and the shorter the determination threshold, the shorter a delay time may be set. In this configuration, the detected load value Ws exceeds the determination threshold, for example, because an occupant (child) temporarily carries baggage. In this case, when the child occupant releases his or her hand from the baggage, the occupant determination state is immediately switched from the different determination (adult occupant determination) to the actual determination (child occupant determination). In addition, in the case where an adult occupant is replaced with a child occupant, the more immediately the adult occupant determination is switched to the actual determination (child occupant determination), the lighter the weight of the child occupant is.

[0035]

Next, technical concepts, which can be grasped from the above-described embodiment, will be described below including relevant effects.

(i) An occupant determining device includes a load sensor arranged at a seat body and a controller calculating a detected load value in accordance with an output load value of the load sensor and performing an occupant determination based on the detected load value, wherein the occupant determination state is switched to an adult occupant determination by setting a delay time when the detected load value exceeds a determination threshold and a greater or less relation between the detected load value and the determination threshold is inversed, wherein the controller includes a plurality of the determination thresholds, and the larger determination threshold exceeded by the detected load value is, the shorter the delay time is set by the controller.

[0036]

(ii) In the occupant determining device described in (i) above, the load sensor is characterized in that at least four load sensors are arranged at right and left positions of the front and rear portions of the seat body.

[0037]

(iii) In the occupant determining device described in any of Claims 1, 2 and the above

(i), (ii), the output load value is processed while being passed through a low-pass filter.

[0038]

[Effect of the invention]

As described above, according to the present invention described in Claim 1, the adult occupant determination can be appropriately made on the basis of the weight of an occupant.

[0039]

According to the present invention described in Claim 2, a calculation load for the adult occupant determination based on the weight of the occupant can be reduced.

[Brief description of drawings]

Fig. 1 is a perspective view illustrating an embodiment of a vehicle seat according to the present invention;

Fig. 2 is a lateral view illustrating the embodiment of the present invention;

Fig. 3 illustrates front views showing front and rear sensor brackets, respectively, according to the embodiment of the present invention;

Fig. 4 is a block diagram showing an electric structure according to the embodiment of the present invention;

Fig. 5 is a time chart showing an occupant determination mode according to the embodiment of the present invention; and

Fig.6 is a time chart showing an occupant determination mode according to the embodiment of the present invention.

[Description of reference numerals]

1	Seat body
20	Occupant determining device
21	Right-side front load sensor configuring a load sensor
22	Left-side front load sensor configuring a load sensor
23	Right-side rear load sensor configuring a load sensor
24	Left-side rear load sensor configuring a load sensor
25	Controller

[DOCUMENT] Abstract

[Abstract]

[Object]

To provide an occupant determining device capable of appropriately performing an adult occupant determination based on the weight of an occupant.

[Means to solve]

An occupant determining device 20 includes load sensors 21 to 24 arranged at a seat body 1 and a controller 25 calculating a detected load value based on load values of the load sensors 21 to 24 and performing an occupant determination based on a greater or less relation between the calculated detected load value and a predetermined determination threshold. Further, the controller 25 sets a delay time and switches the occupant determination state to an adult occupant determination when the calculated detected load value exceeds the determination threshold and the greater or less relation is inversed. The controller 25 includes two determination thresholds, and the larger each determination threshold exceeded by the detected load value is, the shorter the delay time is set.

[Selected drawing]

FIG. 4

FIG. 1

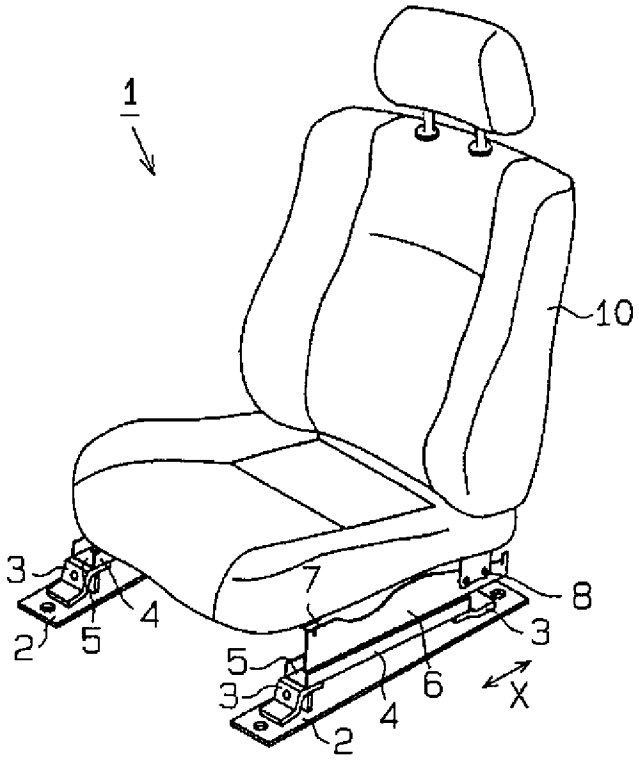


FIG. 2

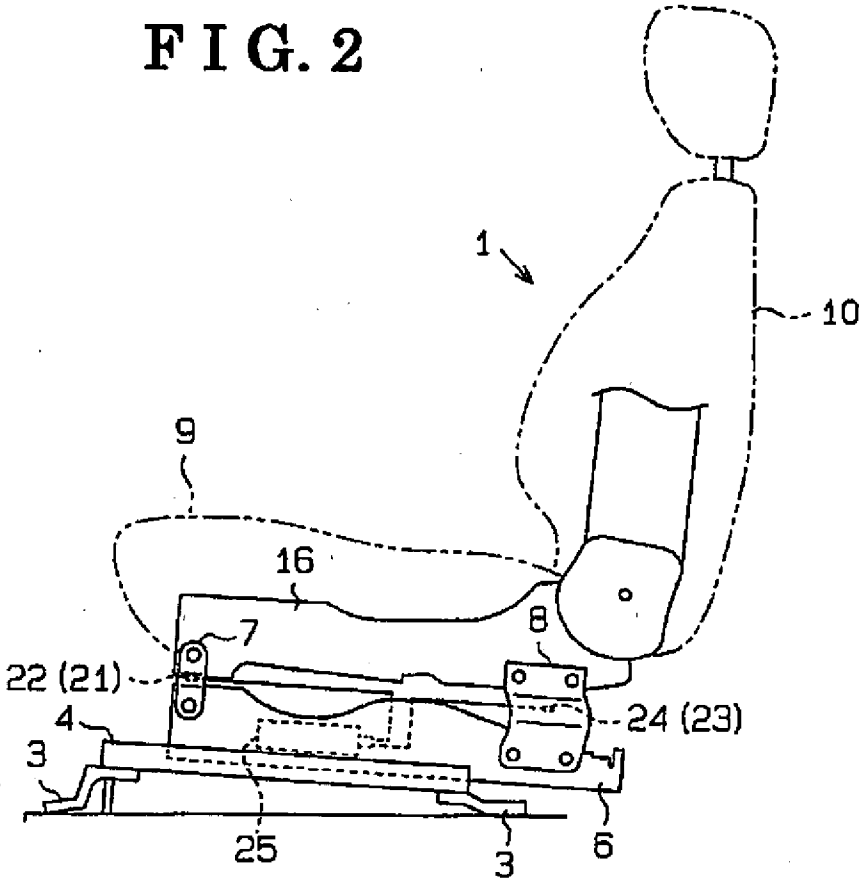


FIG. 3

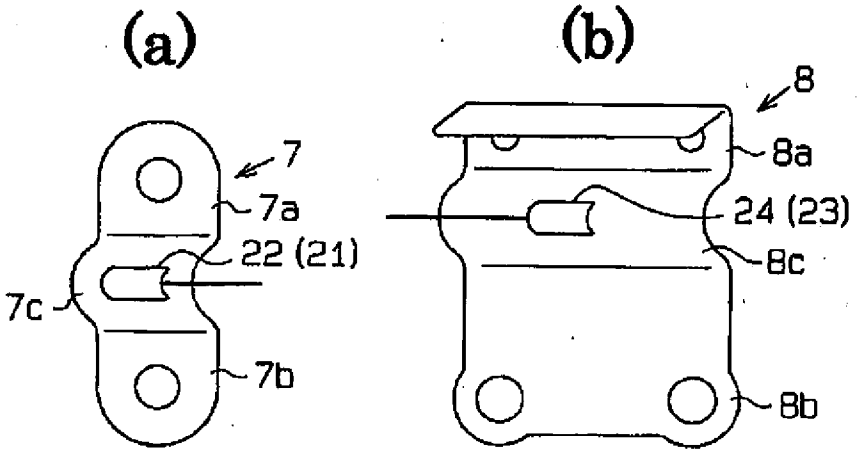


FIG. 4

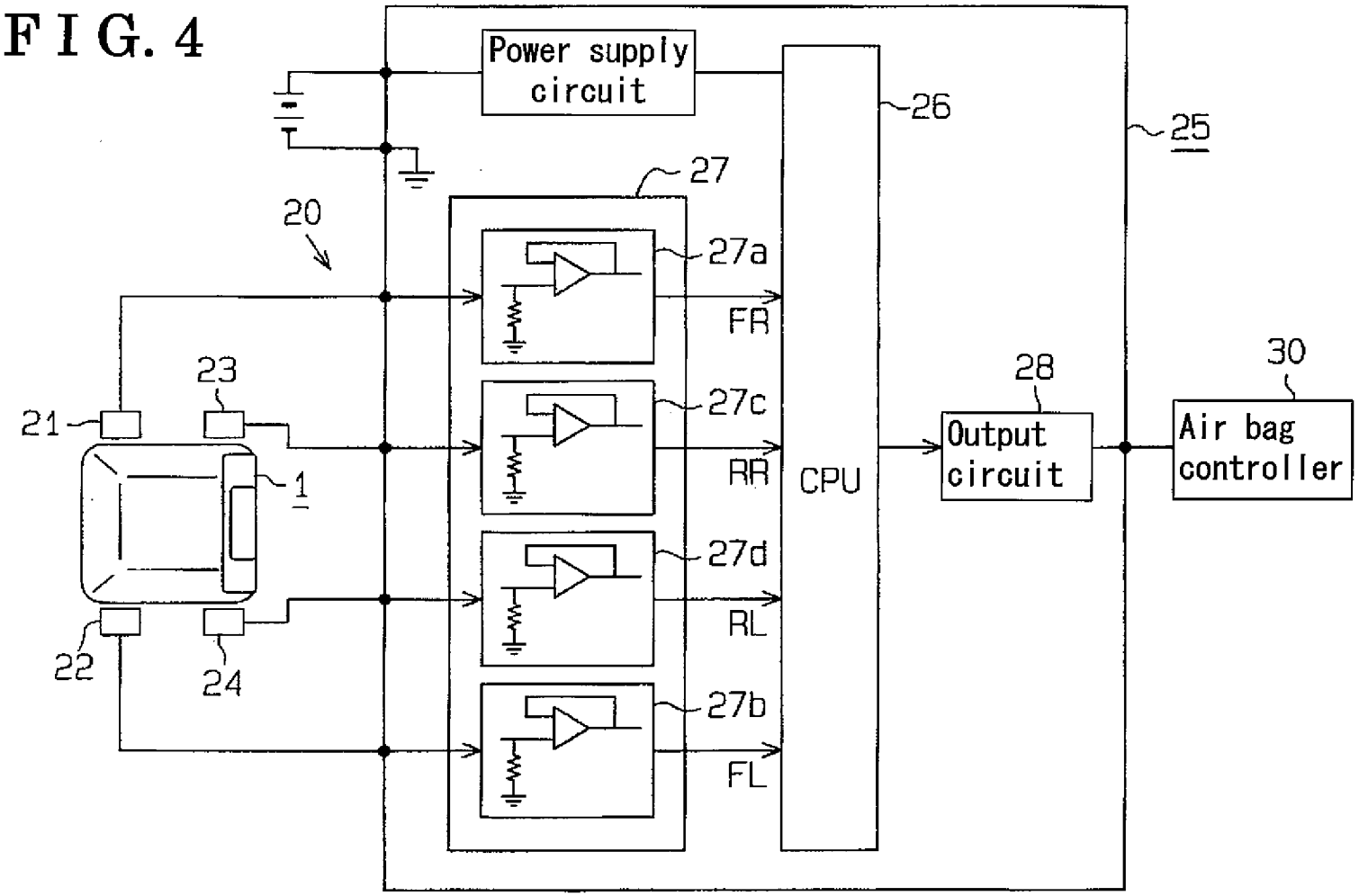

Power supply circuit
26
25
27
20
27a
FR
23
28
30
21
27c
RR
CPU
Output circuit
Air bag controller
1
27d
RL
22
24
27b
FL

FIG. 5

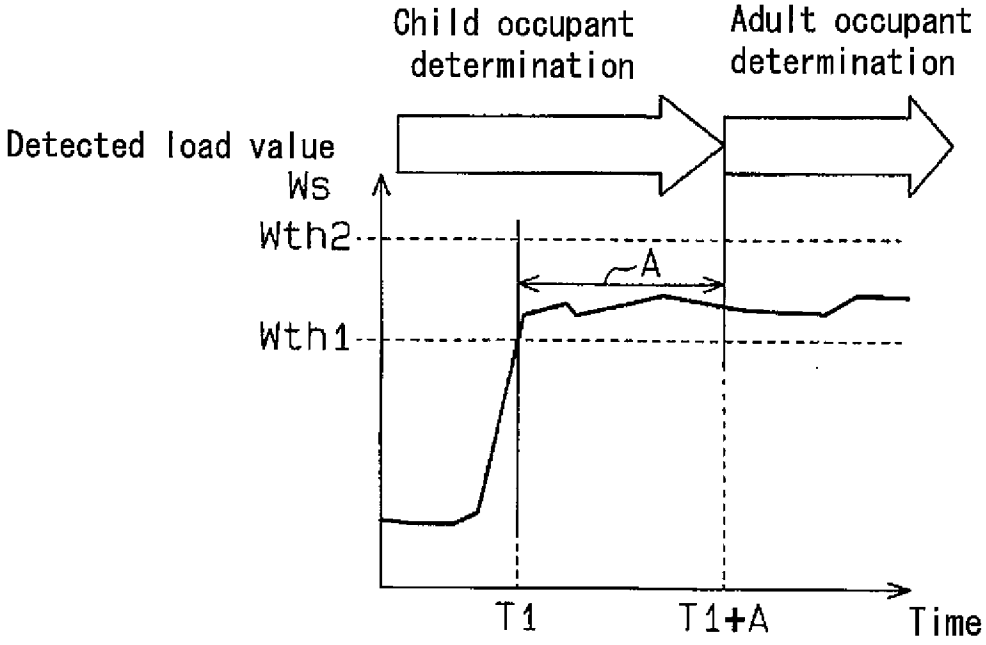
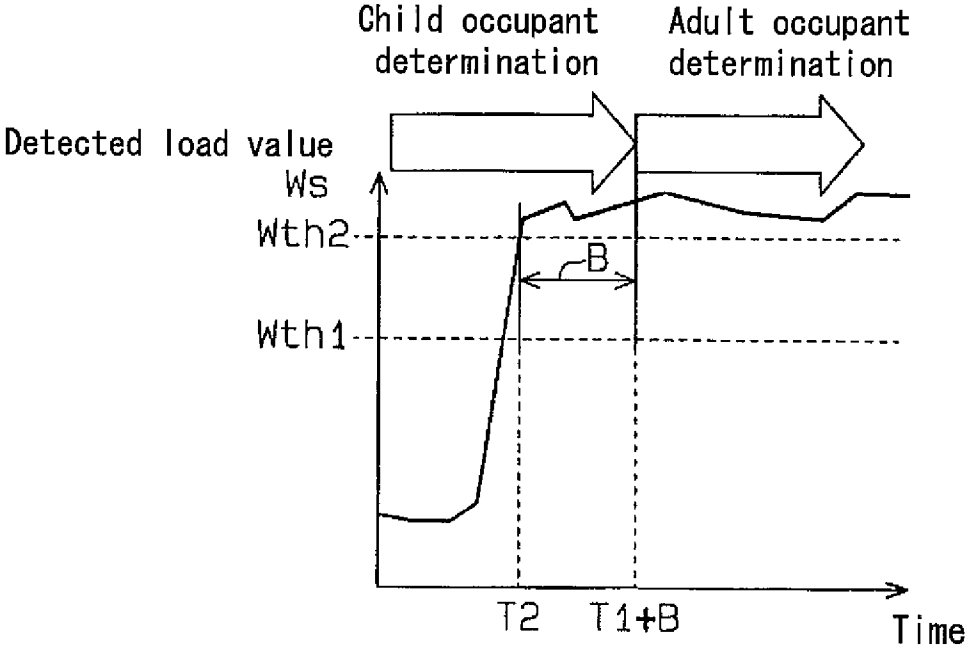

Child occupant determination
Adult occupant determination
Detected load value Ws
Wth2
Wth1
A
T1
T1+A
Time

FIG. 6


Child occupant determination
Adult occupant determination
Detected load value Ws
Wth2
Wth1
B
T2
T1+B
Time